

15'

07'30"

111°00'

Jesse Bigler Monument
on Lightning Ridge 52'30"

9

10

11

12

13

R. 6 E.

R. 7 E.

R. 8 E.

R. 9 E.

R. 9 W.

SALT LAKE
MERIDIAN

UINTAH
MERIDIAN

MIRROR LAKE
& EVANSTON WYOMING



T. 3 N.

37'
30"

A

T. 2 N.

PLEASE REFER TO
ASHLEY
NATIONAL
FOREST
TRAVEL
MAP

B

40'
30"

T. 1 N.

room. Opaque shades send all the light into the room. Translucent shades transmit some light, but shades tend to color the light. Shades with white or near white linings reflect light.

Even if enough light is provided for an activity, a person may be uncomfortable if the light is reflected directly into the eyes, which can cause discomfort. Severe glare is caused by the headlights of some automobiles. Lamps and fixtures that produce more light tend to produce more glare.

A clear glass bulb gives off harsh, unglazed light. Lamps with frosted, or white, shades give some diffusion, but still should be positioned so they do not shine directly in the eyes. A globe or diffusion bowl can soften the bulb and help scatter and soften the light.

Light source does not cause glare directly, but it may reflect it. They include glossy finishes on furniture, and paper, which can produce sharp color contrasts on work surfaces. Paper on a dark blotter, may also cause glare. The color contrast helps the eyes see the light in time it strains the eyes, which must move from a light to a dark area.

Glare in the brightness of lighting can be a problem. For this reason, a person should avoid vision in a completely dark room or study under a single intense lamp. To avoid harsh glare, general lighting in addition to task lighting is recommended.

RECOMMENDED LIGHTING LEVELS

The Illuminating Engineering Society recommends minimum lighting levels for specific activities. Many kinds of lighting fixtures and combinations of devices, can provide these levels. A 200-watt (3660-lumen) incandescent lamp can provide about 70 foot-candles on a desk surface. Two 40-watt (2740-lumen) lamps in a ceiling fixture deliver about 50 foot-candles on an ironing board below them.

Area or Activity	In Foot-Candles	In Luxes
Grooming, shaving, applying makeup	50	540
Preparing and cooking food	150	1,610
Washing and ironing clothes	50	540
Relaxation, conversation	10	110
Table games, cards	30	320
Halls, stairs, entrances	10	110
Books, magazines, newspapers	30	320
Desk study	70	750
Short periods, light colors	50	540
Dark fabrics, low contrast	200	2,200
General office work	100	1,100
Drafting, map making	200	2,200
Extra-fine assembly	1,000	11,000

the light provided by the television screen or the lamp.

Lighting Devices

Many families use combinations of fluorescent and incandescent fixtures and portable lamps for attractive home lighting. Incandescent and fluorescent fixtures may be mounted on a wall or ceiling, recessed above the ceiling, or suspended from the ceiling. Suspended fixtures provide good general lighting for high-ceilinged halls or stairways. Recessed fixtures above sinks or other work areas furnish good lighting for various activities. Many kitchens and family rooms have luminous ceilings, in which fluorescent tubes are hung above the translucent ceiling. Such fixtures provide softly diffused general light. Many institutions, including hospitals, libraries, and schools, also have luminous ceilings.

Portable lamps give homes soft general lighting, and extra lighting for such activities as sewing or studying. The Better Light Better Sight Bureau (BLBS), a non-profit educational organization, sets minimum standards for performance, quality, and safety of study lamps. The organization provides BLBS tags, which the manufacturer attaches to approved lamps.

In homes and small offices, lighting designers may conceal fluorescent tubes behind faceboards mounted at the edges of the walls or ceiling. Such structural lighting provides soft indirect light and draws attention to the walls and draperies. Structural lighting on two opposite walls of a square room makes the lighted walls seem farther apart than the unlighted ones. When mounted on a low ceiling, structural lights give the illusion of greater height in the room.

Most factories, large offices, schools, and stores use fluorescent fixtures for general lighting. Fluorescent lights produce as much as three times the light per watt of electricity as do incandescent lamps. Thus, for the same amount of light, fluorescent lamps cost less to burn. They also produce less heat. However, lighting engineers sometimes prefer incandescent lamps because of their compact size, flexibility of use, or their more familiar warm color. Some stores use a combination of fluorescent fixtures for general lighting and incandescent lamps for decorative or accent lighting.

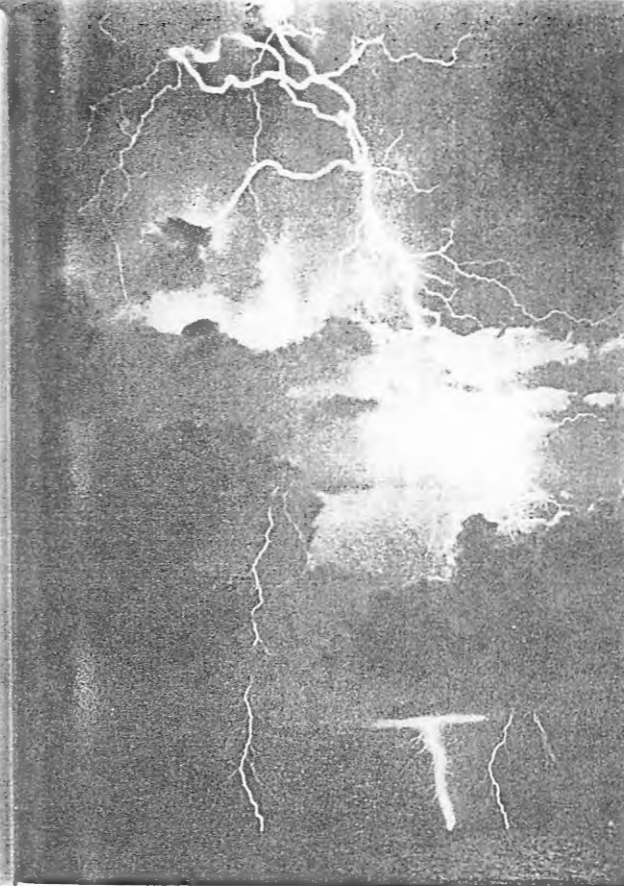
Mercury vapor lamps, mounted from 30 to 50 feet (9 to 15 meters) high on roadways and as high as 150 feet (46 meters) high on freeway interchanges, provide economical highway lighting. They last more than eight times as long as incandescent lamps and give a much higher light level per watt of electricity used. High-pressure sodium vapor lamps are the most efficient man-made light sources. They produce six to eight times as much light per watt as incandescent lamps. These sodium vapor lamps are finding wide use for street and highway lighting.

EDWARD A. CAMPBELL

Related Articles in WORLD BOOK include:

Architecture (Light)	Eye (Using Your Eyes Properly)	Lamp
Beacon	Fluorescent Lamp	Lantern
Candle	Invention	Light
Electric Light	(Inventions That Give Man Light)	Neon
		Theater (Lighting)

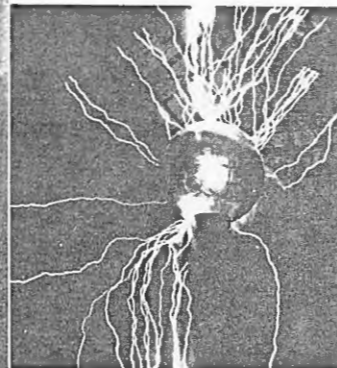
LIGHTNER MUSEUM OF HOBBIES. See **HOBBY** (Hobby Exhibits).



Charles S. Watson, U.S. Weather Bureau

LIGHTNING

Dazzling Forked Lightning flashes through the surrounding clouds and lights up the sky above the ocean. This type of lightning is deadly to swimmers or persons in small boats.



Brown Bros.

Scientists Make Lightning for study in laboratories with large generators that build up sufficient opposite electrical charges to produce an arc.

LIGHTNING is a flash of light in the sky caused by an electrical current. The current may flow between parts of the same cloud, between different clouds, or between clouds and the earth.

A Bolt of Lightning

What Causes Lightning. When a solid body becomes electrically charged, only its surface has a charge. But when a thundercloud becomes charged, the whole cloud has a charge. The cloud actually consists of an immense number of tiny water droplets. Each of these droplets has a charge on its surface. Thus a cloud may have a great electrical potential. If a cloud comes near an oppositely charged cloud, a huge spark may result. When a charged cloud comes near the surface of the earth, an opposite charge is induced on the surface of the earth (see **INDUCTION, ELECTRIC**). The air that separates the cloud and the earth acts as an insulator. It resists the efforts of the opposite charges of electricity to rush together. But when the electrical potential becomes large

enough, it overcomes the resistance of the air. Then a lightning flash occurs. The flash is really a huge spark, similar to that produced in the sparkplug of an automobile. Scientists have found that one stroke of lightning measures more than 15,000,000 volts.

A spark between a cloud and the earth may measure as much as 8 miles (13 kilometers) long. It may travel at a rate of 100,000,000 feet (30,000,000 meters) per second. Lightning that reaches between oppositely charged clouds may have a length of 20 miles (32 kilometers). Photographs of lightning obtained by radar indicate that some cloud-to-cloud lightning strokes may measure 100 miles (160 kilometers) long.

Lightning between clouds does not cause any damage on earth, because the electrical energy is dispersed in the air. But lightning between a cloud and the earth often causes loss of life and property.

How Lightning Produces Thunder. As lightning travels, it heats the air in its path. The sudden heating causes the air to expand violently. The cool air farther

World Book Encyclopedia Vol 12: 263-4 263

Lightning

LIGHTNING

away is pressed into a smaller space. This process starts a great air wave that results in thunder. See THUNDER.

Why Clouds Are Electrified. Meteorologists have given several explanations to account for the electrical charges on clouds. Most scientists believe that it results from the unequal sizes of the water droplets in the clouds. They believe that when water falls through a rising column of air, the larger drops break up into smaller drops of unequal size. The larger of these drops possess a positive electrical charge. The smallest drops have negative charges. Scientists have shown that this situation exists for the spray droplets in waterfalls.

Thunderclouds form at the tops of large rising air currents. The large water drops fall through the rising currents, and split when they reach a certain size. Then the drops become charged and separated. The larger drops become positively charged and continue to fall. The smaller particles retain a negative charge, and the rising air carries them upward. These particles may grow in size, and then fall and separate again. Thus, a continual process of charging takes place. The potential of a cloud

may increase through these continued changes until finally, a flash of lightning occurs.

Kinds of Lightning

All lightning strokes are basically about the same. But they appear to have different forms, depending on the position of the observer.

Forked, Zigzag, or Chain lightning is a chain of brilliant light that appears to zigzag. It actually follows a winding path, like that of a river. The single streak of lightning often breaks into several branches or forks.

Sheet lightning has no particular form. It is usually a bright flash that spreads all over the horizon and lights up the sky. Sheet lightning is really light from a flash of chain lightning that takes place beyond the horizon.

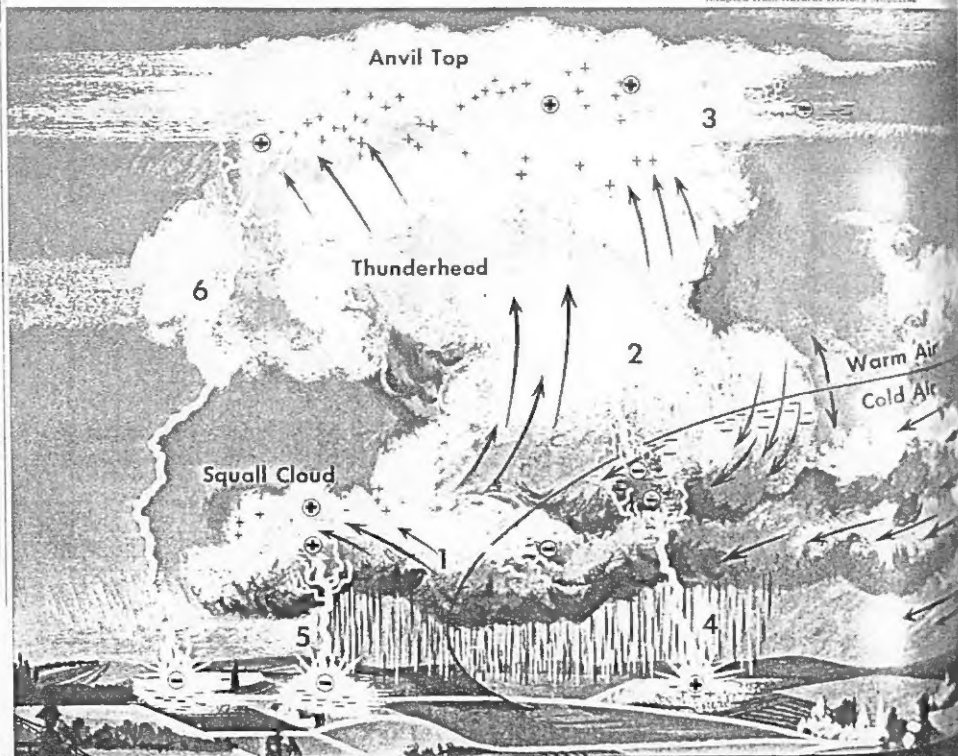
Heat lightning, often seen on summer evenings, is the same as sheet lightning, but the flashes are fainter. Thunder usually does not accompany them. The lightning occurs too far away for thunder to be heard.

Ball lightning seems to consist of balls of fire, as small as walnuts or as large as balloons, that last about three to five seconds. They fall swiftly from the clouds until they strike the ground and explode. Sometimes they

Flashes of lightning take place between a positively charged area and a negatively charged area. These may be different parts of the same cloud, different clouds, or a cloud and the earth. Many scientists believe that updrafts in clouds separate the positive and negative charges. Six different kinds of lightning,

numbered according to frequency of occurrence, include: (1) from front of storm to back; (2) from upper to lower clouds; (3) "glow discharge" into the surrounding air; (4) from low raincloud to the earth; (5) from "squall cloud" to the earth; and (6) from upper cloud to earth. Arrows indicate the movement of air.

Adapted from Natural History Magazine



LIGHTNING SAFETY RULES

Lightning Blasts through the atmosphere at an estimated rate of 2,000,000,000 flashes a year. In the United States alone, it kills one person and injures four others every day.



If Caught Outdoors during a storm, lie down and stay on low ground. Do not seek shelter under a lone tree or stand atop a hill or near a lake.



The Safest Place to be during a storm is in a closed car or a steel frame building that is equipped with lightning rods.



Lightning Strikes the Empire State Building 30 to 48 times a year.



If Indoors, avoid doorways and open windows. Do not touch plumbing fixtures, electric wiring, telephones, and radio and television sets.

U.S. Weather Bureau



Ball Lightning Explodes over the ground like brilliant fireworks.

roll slowly along the ground and do not explode until they hit an obstacle. Ball lightning is the least understood of all forms of lightning. Many meteorologists even doubt that it exists. They think it may be an optical illusion. However, so many reliable witnesses have seen it, that scientists have begun to study it. They have produced ball lightning in the laboratory. This kind of lightning does not appear to be dangerous.

History

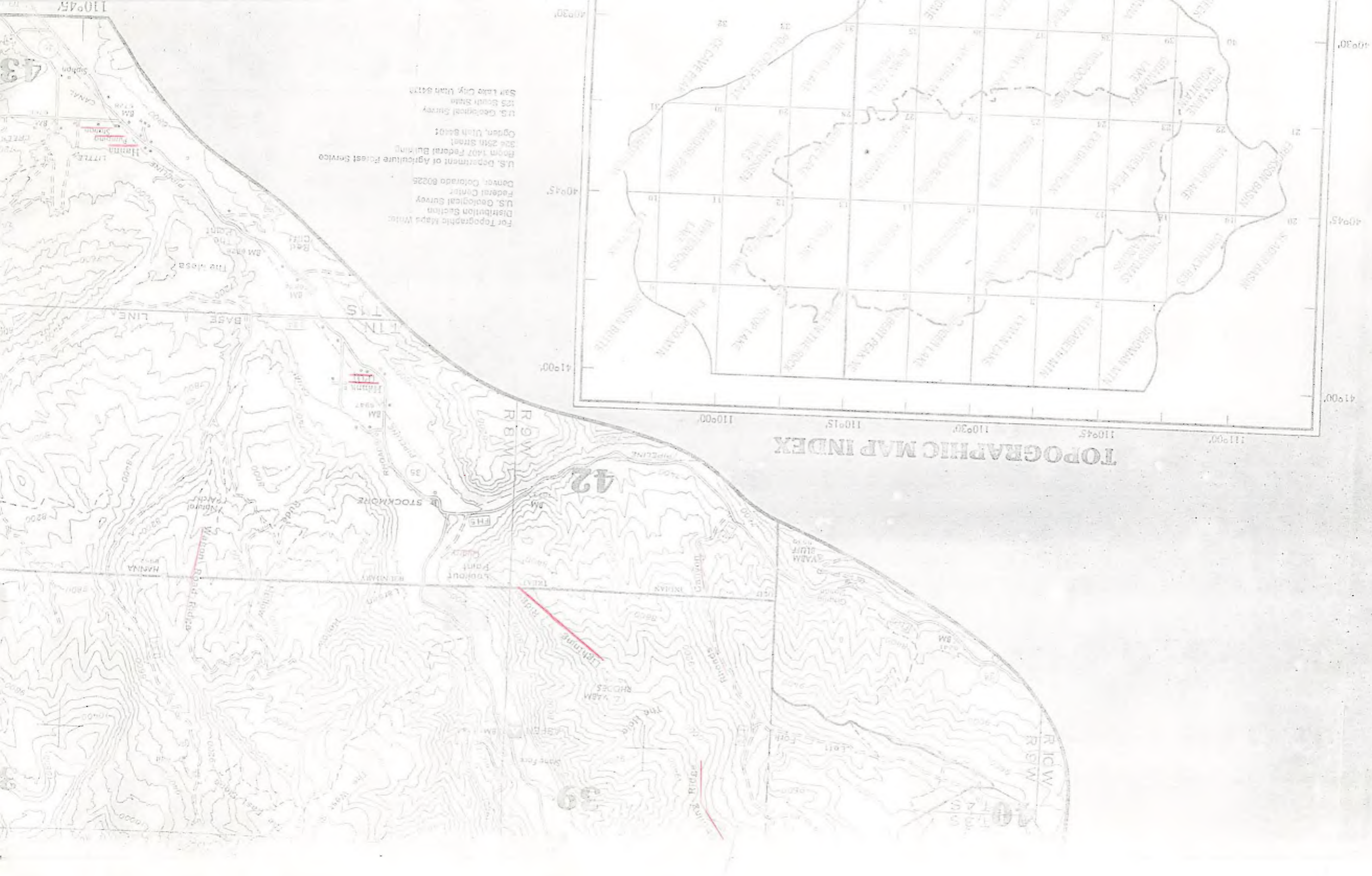
In earliest times, men looked on lightning as one of the great mysteries of nature. The ancient Romans believed that thunder and lightning were the weapons of the god Jupiter. They thought that such powerful and deadly weapons could belong only to the greatest of their gods. Modern science has shown that lightning is really a flow of electricity formed high above the earth. If a man could find a way to use the electrical current in a single lightning flash 1 mile (1.6 kilometers) long, he could light 1,000,000 light bulbs.

Benjamin Franklin showed the connection between electricity and lightning. He made a silk kite and fas-

tened a piece of wire near its top. Then he attached a long string to the kite and tied an iron key to the free end of the string. In 1752, Franklin sent the kite up in a heavy thunderstorm. As a thundercloud came near the kite, Franklin saw the loose ends of the string stiffen. He put his hand near the key and instantly felt a shock as a spark traveled from the key to his finger. Rain then fell heavily. The wet kite carried a large charge of electricity. Franklin collected some of this charge in a device called a Leyden jar. Franklin's experiment was very dangerous. See FRANKLIN, BENJAMIN (Experiments with Electricity); LEYDEN JAR.

In 1752, Franklin built the first lightning rod. This device protects homes and other buildings from damage by lightning. Franklin erected a pointed iron rod on the roof of his house, extending it 5 feet (1.5 meters) into the ground. A metal rod with its lower end in the moist earth and its upper end above the building will protect the building by conducting a lightning flash harmlessly to the earth.

See also ELECTRICITY (How to Use Electricity Safely); LIGHTNING ROD; SAINT ELMO'S FIRE; THUNDER.



For Topographic Maps Write:
U.S. Geological Survey
Federal Center
Denver, Colorado 80225
U.S. Department of Agriculture Forest Service
Room 1407 Federal Building
325 25th Street
Ogden, Utah 84401
U.S. Geological Survey
125 South State
Salt Lake City, Utah 84110

